

**DEPARTMENT-WIDE
FUNCTIONAL AREA QUALIFICATION STANDARD**

CHEMICAL PROCESSING QUALIFICATION STANDARD

Defense Nuclear Facilities Technical Personnel



**U.S. Department of Energy
Washington, D.C. 20585**

October 1995

Approval and Concurrence

The Associate Deputy Secretary for Field Management is the Management Sponsor for the Department-wide Chemical Processing Functional Area Qualification Standard. The Management Sponsor is responsible for reviewing the Qualification Standard to ensure that the technical content is accurate and adequate for Department-wide application. The Management Sponsor, in coordination with the Human Resources organization, is also responsible for ensuring that the Qualification Standard is maintained current. Concurrence with this Qualification Standard by the Associate Deputy Secretary for Field Management is indicated by the signature below.

The Technical Personnel Program Coordinator (TPPC) is responsible for coordinating the consistent development and implementation of the Technical Qualification Program throughout the Department of Energy. Concurrence with this Qualification Standard by the Technical Personnel Program Coordinator is indicated by the signature below.

The Technical Excellence Executive Committee (TEEC) consists of senior Department of Energy managers. This Committee is responsible for reviewing and approving the Qualification Standard for Department-wide application. Approval of this Qualification Standard by the Technical Excellence Executive Committee is indicated by the signature below.

NOTE: **The signatures below reflect concurrence and approval of this Qualification Standard for interim Implementation. Final concurrence and approval will occur by October 1996, pending comments received based upon implementation.**

CONCURRENCE:

Associate Deputy Secretary for
Field Management

Technical Personnel Program
Coordinator

APPROVAL:

Chairman
Technical Excellence Executive Committee

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**U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD**

FUNCTIONAL AREA

Chemical Processing

PURPOSE

The Technical Qualification Program is divided into three levels of technical competence and qualification. The General Technical Base Qualification Standard establishes the base technical competence required of all Department of Energy defense nuclear facility technical personnel. The Functional Area Qualification Standards build on the requirements of the General Technical Base Qualification Standard and establish Department-wide functional competence requirements in each of the identified functional areas. Office/facility-specific Qualification Standards establish unique operational competency requirements at the Headquarters or Field element, site, or facility level.

The Chemical Processing Functional Area Qualification Standard establishes common functional area competency requirements for all Department of Energy chemical processing technical personnel who provide management direction or oversight impacting the safe operation of defense nuclear facilities. Satisfactory and documented completion of the competency requirements contained in this Standard ensures that technical employees possess the minimum requisite competence to fulfill their functional area duties and responsibilities. Additionally, these competency requirements provide the functional foundation to assure successful completion of the appropriate Office/facility-specific Qualification Standard.

APPLICABILITY

This Standard applies to all Department of Energy chemical processing technical personnel who provide management direction or oversight impacting the safe operation of defense nuclear facilities. Personnel designated by Headquarters or Field element line management as participants in the Technical Qualification Program are required to meet the requirements of this Standard as defined in DOE Order 360.1, Training.

IMPLEMENTATION REQUIREMENTS

The competencies contained in the Standard are divided into the following four categories:

1. General Technical
2. Regulatory
3. Administrative
4. Management, Assessment, and Oversight

Each of the categories is defined by one or more competency statements indicated by bold print. The competency statements define the expected knowledge and/or skill that an individual must

possess, and are requirements. Each competency statement is further explained by a listing of supporting knowledge and/or skill statements. The supporting knowledge and/or skill statements are not requirements and do not necessarily have to be fulfilled to meet the intent of the competency.

The competencies identify a familiarity level, working level, or expert level of knowledge; or they require the individual to demonstrate the ability to perform a task or activity. These levels are defined as follows:

Familiarity level is defined as basic knowledge of or exposure to the subject or process adequate to discuss the subject or process with individuals of greater knowledge.

Working level is defined as the knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to reference appropriate materials and/or expert advice as required to ensure the safety of Departmental activities.

Expert level is defined as a comprehensive, intensive knowledge of the subject or process sufficient to provide advice in the absence of procedural guidance.

Demonstrate the ability is defined as the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or Department practices.

Headquarters and Field elements shall establish a program and process to ensure that all defense nuclear facility technical personnel required to participate in the Technical Qualification Program meet the competency requirements contained in this Standard. Documentation of the completion of the requirements of this Standard shall be included in the employee's training and qualification record.

In select cases, it may necessary to exempt an individual from completing one or more of the competencies in this Functional Area Qualification Standard. Exemptions from individual competencies shall be justified and documented in accordance with DOE Order 360.1, Training. Exemptions shall be requested by the individual's immediate supervisor, and approved one level above the individual's immediate supervisor.

Equivalencies may be granted for individual competencies based upon an objective evaluation of the employee's prior education, experience, and/or training. Documentation of equivalencies shall indicate how the competency requirements have been met. The supporting knowledge and/or skill statements may be considered when evaluating an individual's ability with respect to each competency requirement.

Training shall be provided to employees in the Technical Qualification Program who do not meet the competencies contained in the qualification standard. Departmental training will be based upon supporting knowledge and/or skill statements similar to the ones listed for each of the competency statements. Headquarters and Field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training courses used to provide individuals with the requisite knowledge and/or skill required to meet the Qualification Standard competency statements.

DUTIES AND RESPONSIBILITIES

The following are duties and responsibilities normally expected of defense nuclear facility technical personnel assigned to the chemical processing functional area:

- A. Evaluate the adequacy and effectiveness of chemical process safety programs and ensure compliance with the applicable codes, standards, guides, regulations, Department of Energy Orders, and accepted practices.
- B. Monitor and assess contractor performance in the control of chemical processes to include:
 - Operational performance and conditions
 - Training and qualification
 - Regulatory compliance
 - Workplace and process hazards
 - Technical support for process operations
 - Sampling data integrity
- C. Participate in the preparation, review, and/or recommendation for approval of Authorization Basis Documents.
- D. Serve as Department of Energy technical point of contact for:
 - Chemical process operations
 - Chemical process safety issues
 - Training program development
 - Standards review and interpretation
 - Process testing and evaluation
- E. Evaluate contractor emergency preparedness and emergency response activities related to chemical process incidents and provide support in conjunction with contractor, Federal, State, and local officials.
- F. Maintain cognizance of current chemical facility conditions and communicate those conditions to management as appropriate.
- G. Evaluate cost, scope, and schedule associated with chemical processing functions.
- H. Participate in the investigation of incidents related to chemical processes.
- I. Maintain cognizance of facility design basis, facility modifications, operating procedures, and process control.

Additional duties and responsibilities specific to the site, the facility, the operational activities, and/or the involved organizations shall be contained in the Office/facility-specific Qualification Standard(s).

BACKGROUND AND EXPERIENCE

The U. S. Office of Personnel Management's Qualification Standards Handbook establishes minimum education, training, experience, or other relevant requirements applicable to a particular occupational series/grade level, as well as alternatives to meeting specified requirements.

The preferred education and experience for chemical processing personnel is:

1. Education:

Bachelor of Science degree in Chemical Engineering from an accredited institution or meet the alternative requirements specified in the Qualification Standards Handbook for the GS-0800, Professional Engineering Series.

2. Experience:

Industry, facility, operations, or other related experience and/or a Professional Engineer license that has provided background in chemical engineering. Specialized experience can be demonstrated through possession of the competencies outlined in this Standard.

REQUIRED COMPETENCIES

The competencies contained in this Standard are distinct from those competencies contained in the General Technical Base Qualification Standard. All chemical processing personnel must complete the competency requirements of the General Technical Base Qualification Standard prior to or in parallel with the completion of the competency requirements contained in this Standard. Each of the competency statements defines the level of expected knowledge and/or skill that an individual is required to possess to meet the intent of this Standard. The supporting knowledge and/or skill statements further describe the intent of the competency statements but are not requirements.

1. GENERAL TECHNICAL

1.1 Chemical processing personnel shall demonstrate a working level knowledge of steady state heat transfer.

Supporting Knowledge and/or Skills

- a. Define or discuss the following heat transfer terms:
 - Conduction
 - Convection
 - Radiation
 - Thermal conductivity
 - Convectivity
 - Emissivity
 - Transmissivity
- b. Discuss Fourier's Law.
- c. Describe the factors that contribute to the coefficient of thermal conductivity.
- d. Discuss the principles used to determine the temperature gradient for a slab and a cylinder.

1.2 Chemical processing personnel shall demonstrate a working level knowledge of heat transfer principles.

Supporting Knowledge and/or Skills

- a. Discuss the heat flux for one dimensional, steady-state heat transfer through the following:
 - Composite wall
 - Series wall
 - Parallel wall
- b. Discuss the heat flux for transient conditions for heat transfer through the following:
 - Composite wall
 - Series wall
 - Parallel wall
- c. Using the data provided, calculate total heat transfer and local heat flux in a laminar flow system.
- d. Using the data provided, calculate:
 - Prandtl number for a laminar flow system

- Emissivity, absorptivity, and transmissivity

1.3 Chemical processing personnel shall demonstrate a working level knowledge of fluid mechanics.

Supporting Knowledge and/or Skills

- Define or discuss the following fluid mechanics terms:
 - Dynamic viscosity
 - Kinematic viscosity
 - Specific volume
 - Specific gravity
 - Capillarity
 - Cavitation
 - Laminar flow
 - Turbulent flow
 - Prandtl's Number
- Discuss the differences between Newtonian and Non-Newtonian flow.
- Describe the bulk modulus of elasticity and compressibility.
- Describe the effects characterized by Pascal's Law of Fluid Pressure.
- Explain the Equation of Continuity as it applies to fluid flow.
- Discuss the Reynold's number and how it is used.
- Discuss pressurized and non-pressurized flow.
- Discuss Bernoulli's Equation as it applies to steady-state flow rate calculations.
- Describe the characteristics and flow velocity profiles of laminar and turbulent flow.
- Describe the phenomenon of water hammer, pressure spike, and steam hammer.

1.4 Chemical processing personnel shall demonstrate a working level knowledge of thermodynamics.

Supporting Knowledge and Skills

- Define and differentiate among the following:

- Isolated system
 - Closed system
 - Open system
- b. Explain the differences between cyclic, reversible, and irreversible processes.
 - c. Using temperature-volume and pressure-temperature diagrams, describe the changes of state of the material as each of the properties increases.
 - d. Using the steam tables determine the enthalpy, entropy, and specific volume of steam at a given pressure and quality.
 - e. State the First Law of Thermodynamics.
 - f. State the Second Law of Thermodynamics.
 - g. Explain the Carnot cycle and its application to the Second Law of Thermodynamics.
 - h. Define the following thermodynamics terms:
 - Exothermic reaction
 - Endothermic reaction
 - Gibbs free energy
 - Activation energy

1.5 Chemical processing personnel shall demonstrate a working level knowledge of mass and energy balances.

Supporting Knowledge and/or Skills

- a. Given a chemical reaction, balance the reaction equation.
- b. Define/explain the Laws of Conservation of Energy, Mass, and Momentum.
- c. Given the starting quantities for a batch chemical process, determine the limiting reactant, the theoretical product yield, and theoretical waste stream(s).
- d. Given the thermodynamic tables, develop the theoretical energy balance around a chemical process.

1.6 Chemical processing personnel shall demonstrate a working level knowledge of reaction kinetics.

Supporting Knowledge and/or Skills

- a. Define a catalyst and describe its importance in a chemical reaction.
- b. Discuss how the type of chemical reactor, temperature, and contacting pattern affect the reaction rate.

- c. Given a single phase, homogeneous reaction, develop the differential equation for the reaction rate.
- d. Discuss the reaction rate constant and how it can be determined.
- e. Discuss how molecularity and order of a reaction are considered in developing rate equations.

1.7 Chemical processing personnel shall demonstrate a working level knowledge of mass transfer.

Supporting Knowledge and/or Skills

- a. Define the following mass transfer terms:
 - Dew point
 - Bubble point
 - Absorption
 - Adsorption
 - Partition Coefficient
- b. Discuss the vapor-liquid equilibrium laws including:
 - Raoult's Law
 - Dalton's Law
 - Henry's Law
- c. Discuss the relationship between diffusion and pressure, temperature and composition and develop the differential equation.
- d. Describe a probable application for the following:
 - Stripping
 - Extraction
 - Leaching
 - Adsorption
 - Ion exchange
 - Distillation

1.8 Chemical processing personnel shall demonstrate a working level knowledge of measurement, data collection, and analysis.

Supporting Knowledge and/or Skills

- a. Discuss the types of instrumentation used to measure chemical process parameters including:
 - Advantages/disadvantages
 - Accuracy/reliability
 - Signal conversion and output
 - Testing/calibration
- b. Discuss key process parameters used in the trending and analysis of chemical process operations.
- c. Discuss the following with respect to probability and statistics:
 - Standard Deviation
 - Mean/median/mode
 - Variance
 - Sample size/frequency
 - Error analysis
- d. Discuss the relationship between accuracy and precision.

1.9 Chemical processing personnel shall demonstrate the ability to evaluate safety precautions and identify hazards associated with chemicals, compounds, and compressed gases.

Supporting Knowledge and/or Skills

- a. Discuss the hazards associated with the use of corrosives (acids and alkalies).
- b. Describe the general safety precautions necessary for the handling, storage, and disposal of corrosives.
- c. Discuss the general safety precautions for toxic compounds.
- d. Discuss the safety precautions for working with cryogenic liquids.
- e. Describe the general safety precautions regarding the use, handling, and storage of flammable and combustible materials.
- f. Describe the requirements for safe storage and use of the following compressed gases (include flammability and cryogenic considerations):
 - Oxygen
 - Acetylene
 - Hydrogen
 - Nitrogen
- g. Given the Material Safety Data Sheet (MSDS) for hazardous chemicals, describe the specialized personal protective equipment required.

- h. Given the support documentation or reference for specific chemicals, discuss their compatibility and any potential hazards associated with mixing.

1.10 Chemical processing personnel shall demonstrate a familiarity level knowledge of the requirements for using personal protective equipment (PPE).

Supporting Knowledge and/or Skills

- a. Describe the principles governing the selection, use and limitations of the following:
 - Respirators
 - Protective clothing
 - Hearing protection devices
- b. Describe the various types of personal equipment (devices or clothing) worn to protect a worker from chemical exposure, radiological exposure, and physical injury.

1.11 Chemical processing personnel shall demonstrate the ability to read and interpret mechanical diagrams, including:

- **As-built drawings**
- **Piping and Instrumentation Diagrams (P&ID)**

Supporting Knowledge and/or Skills

- a. Using an engineering print, read and interpret the information contained in the title block, the notes and legend, the revision block, and the drawing grid.
- b. Using a piping and instrumentation diagram describe the following:
 - Types of valves
 - Types of valve operators
 - Types of eductors and ejectors
 - Basic types of instrumentation.
 - Types of instrument signal controllers and modifiers
 - Types of system components (pumps, etc.)
 - Types of lines
- c. Identify the symbols used in piping and instrumentation diagrams to denote the location of instruments, indicators, and controllers.
- d. Identify how valve conditions are depicted.
- e. Determine system flowpath(s) for a given valve lineup.
- f. Using a fluid power drawing, determine the operation, or resultant action of the stated component, when hydraulic pressure is applied/removed.

- g. Discuss the purpose of "as-built drawings."
- h. Given an operating procedure or test procedure, use a system diagram to verify its adequacy.

1.12 Chemical processing personnel shall demonstrate a familiarity level knowledge of techniques for environmental compliance-related sampling and monitoring.

Supporting Knowledge and/or Skills

- a. Describe the types of equipment used to monitor a site for the following:
 - Ambient air quality
 - Emissions
 - Groundwater
 - Meteorological factors
 - Streams and rivers
 - Soil and sediment
 - Wildlife
- b. Explain the reason for measuring emissions, meteorological factors, and ambient air quality under the various operating conditions (e.g., routine, emergency).
- c. Describe the purpose for measuring each of the following parameters during field surveys of water quality:
 - Temperature
 - Dissolved oxygen
 - Conductivity
 - pH
- d. Discuss the factors that can affect readings, and the preservation methods for the field measurements listed above.
- e. Describe how trace toxic organics, volatile organics, and heavy metals are measured.

1.13 Chemical processing personnel shall demonstrate a familiarity level knowledge of maintenance management practices related to chemical processing activities.

Supporting Knowledge and/or Skills

- a. Define each of the following maintenance related terms and explain their relationship to each other.
 - Corrective

- Planned
 - Preventive
 - Reliability Centered
 - Predictive
- b. Describe the elements of an effective work control program and the documentation used to control maintenance.
 - c. Discuss the importance of maintaining a proper balance of preventive and corrective maintenance.
 - d. Define the term "life limiting component" and discuss its impact on facility operation.
 - e. Identify typical maintenance performance indicators, and discuss their importance.
 - f. Discuss the relationship between maintenance and Conduct of Operations, Quality Assurance, and Configuration Management.
 - g. Discuss the requirements for the receipt and inspection of parts, materials, and equipment.
 - h. Describe the difference between temporary and permanent repairs/work and the requirements and controls in place to prevent inadvertent modifications.

1.14 Chemical processing personnel shall demonstrate a familiarity level knowledge of the principles and concepts of natural phenomena hazards and their effect on chemical processing systems.

Supporting Knowledge and/or Skills

- a. Discuss the potential impact on chemical processing systems at defense nuclear facilities from the following natural hazards:
 - Flooding
 - Wind
 - Tornado
 - Earthquake and/or other seismic events
 - Fire
 - Lightning
- b. Briefly describe the safety measures and design features commonly used as safeguards against natural hazards.

1.15 Chemical processing personnel shall demonstrate a working level knowledge of chemical process and equipment design.

Supporting Knowledge and/or Skills

- a. Describe the design features and treatments employed to reduce/eliminate the following:
 - Galvanic corrosion
 - General corrosion
 - Erosion
 - Pitting corrosion
 - Stress corrosion cracking

- b. Discuss the operation of process ventilation systems and their effect on:
 - Personnel safety
 - Process parameters
 - Equipment
 - Facilities

- c. Given a chemical processing flowpath/stream, discuss the design specifications to be considered in the selection of the following components:
 - Pumps
 - Strainers/filters
 - Valves/valve operators
 - Storage tanks
 - Evaporators/concentrators
 - Piping/material
 - Chemical Reactors

2. REGULATORY

NOTE: When Department of Energy (DOE) directives are referenced in the qualification standard, the most recent revision should be used.

2.1 Chemical processing personnel shall demonstrate a familiarity level knowledge of General Design Criteria requirements contained in the following:

- DOE Order 6430.1A, General Design Criteria
- DOE Order 430.1, Life-Cycle Asset Management

Supporting Knowledge and/or Skills

- a. Discuss the identification of design requirements for chemical processing systems in Department facilities.
- b. Discuss the relationship between industry standards and the General Design Criteria.
- c. Discuss the characteristics of a safety class item as defined in the General Design Criteria.
- d. Discuss the application of single failure criteria to chemical processing systems.
- e. Discuss the environmental qualification criteria for chemical processing system equipment.
- f. Discuss the requirements for testing capability for chemical processing systems as specified in the General Design Criteria.
- g. Discuss the criteria for generic human factors engineering considerations in the General Design Criteria, as they apply to chemical processing systems.

2.2 Chemical processing personnel shall demonstrate a familiarity level knowledge of Department of Energy (DOE) Standard (STD) DOE-STD-1073-93, Guide for Operational Configuration Management Program.

Supporting Knowledge and/or Skills

- a. Describe the purpose and objectives of the Operational Configuration Management Program.
- b. Discuss what constitutes acceptable contractor performance consistent with the requirements of DOE-STD-1073-93, Guide for Operational Configuration Management Program, for the following elements of the contractor's Configuration Management Plan:

- Program planning
 - Equipment scope criteria
 - Concepts and terminology
 - Interfaces
 - Databases
 - Procedures
- c. Discuss the following elements of the Configuration Management Program:
- Design requirements
 - Document control
 - Change control
 - Assessments
 - Design reconstitution adjunct
 - Material condition and aging adjunct
- d. Discuss the purpose, concepts, and general process for applying the graded approach to operational configuration management.

2.3 Chemical processing personnel shall demonstrate a familiarity level knowledge of the Department of Energy, DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information.

Supporting Knowledge and/or Skills

- a. State the purpose of DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information.
- b. Define the following terms:
- Event
 - Condition
 - Facility
 - Notification report
 - Occurrence report
 - Reportable occurrence
- c. Discuss the Department's policy regarding the reporting of occurrences as outlined in the DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information.
- d. State the different categories of reportable occurrences and discuss each.
- e. Refer to Attachment 1 of DOE Order 5000.3B, Occurrence Reporting and Processing of Operations Information, and discuss the role of chemical processing personnel in chemical processing-related reportable occurrences.

2.4 Chemical processing personnel shall demonstrate a working level knowledge of DOE Order 5480.21, Unreviewed Safety Questions.

Supporting Knowledge and/or Skills

- a. Discuss the reasons for performing an Unreviewed Safety Question determination.
- b. Define the following terms:
 - Accident Analyses
 - Safety Evaluation
 - Technical Safety Requirements
- c. Describe the situations in which a safety evaluation is required to be performed.
- d. Define the conditions for an Unreviewed Safety Question.
- e. Describe the responsibilities of contractors authorized to operate defense nuclear facilities regarding the performance of safety evaluations.
- f. Describe the actions to be taken by a contractor upon identifying information that indicates a potential inadequacy of previous safety analyses or, a possible reduction in the margin of safety as defined in the Technical Safety Requirements.
- g. Discuss the qualification and training requirements for personnel who perform safety evaluations.
- h. Discuss the actions to be taken if it is determined that an Unreviewed Safety Question is involved.
- i. Discuss the following terms as they apply to Unreviewed Safety Questions:
 - Categorical exclusions
 - Prior Unreviewed Safety Question safety evaluations
 - Inconsequential changes
 - Margin of Safety
 - Design Basis Accidents
 - Important to Safety
 - Authorization Basis

2.5 Chemical processing personnel shall demonstrate a working level knowledge of the Technical Safety Requirements as described in DOE Order 5480.22, Technical Safety Requirements.

Supporting Knowledge and/or Skills

- a. Discuss the purpose of the Technical Safety Requirements.
- b. Describe the responsibilities of contractors authorized to operate defense nuclear facilities regarding the Technical Safety Requirements.

- c. Define the following terms and discuss the purpose of each:
 - Safety limit
 - Limiting control settings
 - Limiting conditions for operation
 - Surveillance requirements
- d. Describe the general content of each of the following sections of the Technical Safety Requirements:
 - Use and application
 - Safety limits
 - Operating limits
 - Surveillance requirements
 - Administrative controls
 - Basis
 - Design features
- e. Discuss the definition and implementation principles for the term OPERABILITY as used in a Technical Safety Requirement.
- f. Discuss the conditions that constitute a violation of the Technical Safety Requirements and state the reporting requirements should a violation occur.
- g. Discuss the requirements for administrative control of the Technical Safety Requirements.
- h. Discuss the possible source documents that may be used in developing Technical Safety Requirements.
- i. Differentiate between the following facility designations:
 - Category A reactor facility
 - Category B reactor facility
- j. Discuss the requirements for emergency actions that depart from the approved Technical Safety Requirements.

2.6 Chemical processing personnel shall demonstrate a working level knowledge of Nuclear Safety Analysis Reports as described in DOE Order 5480.23, Nuclear Safety Analysis Reports or DOE Order 5481.1B, Safety Analysis and Review System, as applicable.

Supporting Knowledge and/or Skills

- a. Discuss the basic purposes and objectives of Safety Analysis Reports.
- b. Describe the responsibilities of contractors regarding the development and maintenance of a Safety Analysis Report.

- c. Define the following terms and discuss the purpose of each:
 - Design basis
 - Authorization basis
 - Engineer safety features
 - Safety analysis
- d. Describe the requirements for the scope and content of a Safety Analysis Report and discuss the general content of each of the required sections of a Safety Analysis Report.
- e. Discuss the ways that contractor management makes use of Safety Analysis Reports.
- f. Define who approves facility operations prior to achieving Safety Analysis Report upgrade approval.
- g. Discuss the provisions for temporary and permanent exemptions from the requirements of Safety Analysis Reports.
- h. Discuss the requirements for the contractor to maintain the Safety Analysis Report current.

2.7 Chemical processing personnel shall demonstrate a familiarity level knowledge of the following Department of Energy (DOE) Standards and the Order related to natural phenomena hazards :

- **DOE-STD-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities**
- **DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components**
- **DOE-STD-1022-94, Natural Phenomena Hazards Site Characterization Criteria**
- **DOE Order 5480.28, Natural Phenomena Hazards Mitigation**

Supporting Knowledge and/or Skills

- a. Describe the purpose, scope, and application of the requirements detailed in the standards and Order listed above.
- b. Discuss the graded approach process that Department line management uses to determine an appropriate level of coverage by mechanical systems personnel. Include in this discussion the factors that may influence the level of coverage.
- c. Determine contractor compliance with the listed documents as they apply to contract design requirements and mechanical system activities at a Department defense nuclear facility.

2.8 Chemical processing personnel shall demonstrate a familiarity level knowledge of the following Department of Energy (DOE) Orders:

- **DOE Order 4700.1, Project Management System**
- **DOE Order 430.1, Life-Cycle Asset Management**

Supporting Knowledge and/or Skills

- a. Discuss the purpose, scope, and application of the DOE Orders listed above. Include in this discussion the key terms, essential elements, and personnel responsibilities and authorities.
- b. Discuss the project management terminology for which definitions are provided in DOE Orders listed above.
- c. Discuss in detail the roles played by various management levels within the Department as they relate to project management.
- d. Discuss the purpose of "critical decisions." Include in the discussion the responsible authorities for critical decisions.
- e. Describe the process by which projects are designated.

2.9 Chemical processing personnel shall demonstrate the ability to evaluate the adequacy of local compliance with the following sections of 29 CFR 1910, Occupational Safety and Health Standards:

- **1910.119, Process Safety Management of Highly Hazardous Chemicals**
- **1910.120, Hazardous Waste Operations and Emergency Response**
- **1910.1200, Hazard Communication**

Supporting Knowledge and/or Skills

- a. Describe the purpose, scope, and application of the listed regulations.
- b. Discuss what constitutes acceptable contractor work performance with the requirements of the above regulations.
- c. Discuss the process by which Department line management determines an appropriate level of coverage by chemical processing personnel. Include in this discussion factors that may influence the level of coverage.

- d. Using the appropriate regulation, assess the adequacy of training on HAZCOM in the following areas:
 - Methods and observations to detect the presence or release of hazardous chemicals
 - Physical and health hazards of chemicals in the workplace
 - Measures employees can take to protect themselves
 - Use of information contained on labels and Material Safety Data Sheets
- e. Given data from an evaluation, analyze the results of the evaluation to determine contractor compliance or noncompliance with the requirements.
- f. Discuss the purpose of the Process Hazard Assessment.

2.10 Chemical processing personnel shall demonstrate a familiarity level knowledge of transportation and safety requirements for radioactive and hazardous materials in the following Department of Energy (DOE) Orders:

- **DOE Order 1540.2, Hazardous Material Packaging for Transport - Administrative Procedure**
- **DOE Order 1540.3A, Base Technology for Radioactive Material Transportation Packaging Systems**
- **DOE Order 5480.3, Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances and Hazardous Wastes**

Supporting Knowledge and/or Skills

- a. Discuss the purpose and scope of the Orders listed above.
- b. Discuss the applicability and impact of the Orders listed above on chemical processing activities.
- c. Describe the authorities and responsibilities of chemical processing personnel with respect to the Orders listed above.

2.11 Chemical Processing personnel shall demonstrate a familiarity level knowledge of the following emergency management related Department of Energy (DOE) Orders:

- **DOE Order 5500.1, Emergency Management System**
- **DOE Order 5500.2, Emergency Categories, Classes, and Notification and Reporting Requirements**
- **DOE Order 5500.3, Planning and Preparedness for Operational Emergencies**
- **DOE Order 5500.7, Emergency Operating Records Protection Program**
- **DOE Order 5500.10, Emergency Readiness Assurance Program**

Supporting Knowledge and/or Skills

- a. Describe the purpose of the Orders listed above.
- b. Discuss the general roles and responsibilities of the departmental elements for management of the Department's Emergency Management System.
- c. Define "Operational Emergencies" and the circumstances to which they apply.
- d. Discuss the classes of hazards contained in DOE Order 5500.1, Emergency Management System.
- e. Discuss the Department's three-tiered organizational approach to managing Operational Emergencies.

- f. Describe the purpose of an Emergency Readiness Assurance Plan.

2.12 Chemical processing personnel shall demonstrate a familiarity level knowledge of the following Department of Energy (DOE) Orders and their application to chemical processing activities:

- **DOE Order 5480.24, Nuclear Criticality Safety**
- **DOE Order 5480.31, Startup and Restart of Nuclear Facilities**

Supporting Knowledge and/or Skills

- a. Discuss the purpose, scope, and applicability of the Orders listed above.
- b. Discuss the Management and Operating (M&O) Contractor responsibilities for the following in relation to criticality safety activities:
- Critical safety evaluations
 - Monitoring
 - Surveillance
 - Transportation
 - Storage
- c. Define the following terms as they relate to DOE Order 5480.31, Start-up and Restart of Nuclear Facilities, and nuclear safety:
- Facility shutdown
 - Operational readiness review
 - Plan-of-action
 - Prestart finding
 - Readiness assessment
 - Unplanned shutdown
- d. Discuss the role of Department chemical processing personnel with respect to the implementation of the requirements of the Orders listed above.

3. ADMINISTRATIVE

NOTE: When Department of Energy (DOE) directives are referenced in the qualification standard, the most recent revision should be used.

3.1 Chemical processing personnel shall demonstrate a familiarity level knowledge of the training and qualification program(s) requirements identified in the following Department of Energy (DOE) Orders:

- DOE Order 5480.18B, Nuclear Facility Training Accreditation Program
- DOE Order 5480.20A, Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities.
- DOE Order 360.1, Training

Supporting Knowledge and/or Skills

- a. Discuss the meaning of "qualification" and its importance to quality.
- b. Describe the purpose and scope of the DOE Orders listed above.
- c. Discuss why certain skills or proficiencies should be demonstrated periodically.
- d. Describe the types of changes to a program or process that require modification to a training program.

4. MANAGEMENT, ASSESSMENT, AND OVERSIGHT

NOTE: When Department of Energy (DOE) directives are referenced in the qualification standard, the most recent revision should be used.

4.1 Chemical processing personnel shall demonstrate a familiarity level knowledge of financial management practices and the application of contractor resources to meet commitments to the quality, safety, cost, and schedule.

Supporting Knowledge and Skills

- a. Describe the process for preparing cost estimates and budgets.
- b. Describe and contrast direct and indirect costs. List ways to reduce indirect costs.
- c. Describe the types of data required to forecast cost and schedule performance.
- d. Discuss the importance of formal change control in relation to project management.

4.2 Chemical processing personnel shall demonstrate a working level knowledge of assessment techniques, reporting, and follow-up actions as they apply to contractor performance.

Supporting Knowledge and/or Skills

- a. Describe the role of chemical processing personnel in performance oversight of government-owned, contractor-operated (GOCO) facilities.
- b. Describe the assessment requirements and limitations associated with the interface of chemical processing personnel and contractor employees.
- c. Describe how planning, observations, interviews, and document research are used during an assessment.
- d. Explain the essential elements of a performance-based assessment including investigation, fact-finding, and reporting. Include a discussion of the essential elements and processes of the following assessment activities:
 - Interviews
 - Closure process
 - Tracking to closure
 - Follow-up
 - Contractor corrective action implementation
- e. Describe the actions to be taken if the contractor challenges the assessment findings and explain how such challenges can be avoided.

- f. Compare and contrast the following:
 - The Department of Energy's expectations of a Management and Operating (M&O) contractor.
 - Management and Operating (M&O) contractor's expectations of the Department of Energy.
- g. Discuss the key elements and features of an effective Department of Energy Management and Operating (M&O) contractor relationship.

4.3 Chemical processing personnel shall demonstrate the ability to assess contractor chemical processing activities and make all necessary reports.

Supporting Knowledge and/or Skills

- a. Using different sets of performance data, compare and contrast the data to highlight acceptable and unacceptable work performance.
- b. Describe the methods by which noncompliance or nonperformance is determined and communicated to contractor and Department management.
- c. Describe the role of chemical processing personnel in the contractor performance evaluation process.
- d. Using selected sections from Orders, regulations, and technical standards, prepare an action plan which adequately outlines interviews and observations, and details documents to review during an evaluation of contractor performance against the requirements of the selected sections.
- e. Using an appropriate level of coverage, evaluate contractor performance against the requirements of selected sections of Orders, regulations, and technical standards. During this evaluation, demonstrate the ability to properly conduct interviews, observations, and document reviews.
- f. Participate in formal meetings between Department management and senior contractor management to discuss the results of chemical processing assessments.
- g. Given the results from an analysis of contractor performance, document the results to contractor and Department line management.

4.4 Chemical processing personnel shall demonstrate a working level knowledge of problem analysis principles and the ability to apply techniques necessary to identify problems, determine potential causes of problems, and identify corrective action(s).

Supporting Knowledge and/or Skills

- a. Describe and explain the application of problem analysis techniques including the following:
 - Root cause analysis
 - Causal factor analysis
 - Change analysis
 - Barrier analysis
 - Management Oversight Risk Tree (MORT) analysis
- b. Describe and explain the application of the following root cause analysis processes in the performance of occurrence investigations:
 - Event and causal factors charting
 - Root cause coding
 - Recommendation generation
- c. Describe and explain the application of DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements, in the investigation of occurrences.
- d. Using event and/or occurrence data, apply problem analysis techniques and identify the problems and how they could have been avoided.

4.5 Chemical processing personnel shall demonstrate a working level knowledge of Department of Energy (DOE) maintenance management requirements as defined in DOE Order 4330.4B, Maintenance Management Program.

Supporting Knowledge and/or Skills

- a. Explain the Department's role in the oversight of contractor maintenance operations.
- b. Identify the key elements of a contractor maintenance plan as required by DOE Order 4330.4B, Maintenance Management Program.
- c. Describe configuration control and its relationship to the maintenance work control process and the maintenance history file.
- d. Describe the mechanisms for feedback of relevant information, such as trend analysis and instrumentation performance/reliability data, to identify necessary program modifications.
- e. Review a contractor preventive maintenance program and describe the factors to be considered.
- f. Discuss the importance of post-maintenance testing and the elements of an effective post-maintenance testing program.
- g. Review the results of post-maintenance testing activities and discuss the acceptance of post-maintenance testing.

- h. Discuss the importance of maintaining a maintenance history.
- i. Review a maintenance history file and discuss the potential implications of repeat maintenance items.
- j. Explain the intent of a Maintenance Problem Analysis Program and discuss a maintenance problem where this program has been employed.

EVALUATION REQUIREMENTS

The following requirements shall be met to complete the Department-wide Chemical Processing Functional Area Qualification Standard. The evaluation process identified below serves as a measurement tool for assessing whether the participants have acquired the technical competencies outlined in this Standard.

1. Documented completion of the Department-wide General Technical Base Qualification Standard in accordance with the requirements contained in that standard.
2. Documented completion of the competency requirements listed in this Functional Area Qualification Standard. Documentation of the successful completion of these competency requirements may be satisfied by a qualifying official using any of the following methods:
 - Documented evaluation of equivalencies
 - Written examination
 - Documented oral evaluation
 - Documented observation of performance

CONTINUING TRAINING AND PROFICIENCY REQUIREMENTS

Chemical processing personnel shall participate in an Office/facility-specific continuing training and qualification program that includes the following elements:

1. Technical education and/or training covering topics directly related to the duties and responsibilities of chemical processing personnel as determined by line management. This may include courses and/or training provided by:
 - Department of Energy
 - Other Government agencies
 - Outside vendors
 - Educational institutions
2. Training covering topics that address identified deficiencies in the knowledge and/or skill of chemical processing personnel.
3. Training in areas added to the Chemical Processing Functional Area Qualification Standard since initial qualification.
4. Specific continuing training requirements shall be documented in Individual Development Plans (IDPs).